and we are far from this at present—is that we cannot expect complete success in anti-tuberculosis work until we are in a position to say that "we are exercising complete supervision over, and making provision for, the whole of the sick life of the consumptive, whether he is trending towards complete recovery or towards death." There is not a single community in Great Britain concerning which that statement can be affirmed. The nearest approach to it is what is known as the Framingham experiment, which has been going on for four or five years in a small town in Massachusetts, and of which a valuable account has been published by the American Tuberculosis Association. It is to be hoped that a full account of this experiment, and the results which have been obtained, will form part of the proceedings of the forthcoming conference in London.

The Foundations of Physics.

Physics: The Elements. By Dr. Norman R. Campbell. Pp. ix + 565. (Cambridge: At the University Press, 1920.) 40*s.* net.

DR. CAMPBELL has attempted with great courage a very ambitious task—that of discussing critically the fundamental conceptions, propositions, and methods of the science of physics. A rough idea of the nature of his work may be given by saying that he attempts to do for the foundations of physics what Peano, Whitehead, Russell, and others of the modern critical school have done for the central principles of mathematics. The spirit, however, rather than the exact method of these mathematical philosophers is what he emulates, for, apparently, one of the factors which determined him to write this book was a lively dissatisfaction caused by the fact that hitherto all inquiry of this nature in physics has been carried out by mathematicians rather than by experimenters. Mach, of course, in spite of Dr. Campbell's implication, was an experimenter of note, as well as a mathematician and philosopher, but our author aspires to a somewhat more complete and general discussion than that carried out by Mach for certain branches of physics, and wishes to include recent developments. Again, he is more anxious to win the confidence of the man in the laboratory (who, as he says, is often "not merely uninterested in fundamental criticism, but positively hostile to it"), while at the same time desiring to meet the logicians on their own ground, if not with their own weapons. From a window in his study he looks down with sympathy upon the laboratory, and writes with one eye on the bust of Mr. Bertrand Russell, serene above the conflict, and with the other on the working physicist, who is cursing alternately his electrometer and the theory of errors.

Dr. Campbell realises clearly that the physicist is not necessarily either logical or consistent when he is most efficient. This realisation is an important feature of the book, and distinguishes the author from his predecessors. "It is undoubted," he says, "that we can study science with perfect satisfaction to ourselves . . . although we commit the heinous offence of using ambiguous terms. And this fact is simply an indication that we do not use in the course of our study any processes which require words to be unambiguous." "Illogical is not synonymous with erroneous." Again, he insists more strongly upon the fundamental importance of analogy than do most writers on the principles of science, contending that analogies are not so much aids to the establishment of theories—the usual view—as essential parts of the theories. The theories are systematic expressions of analogies. Here, we think, he will not only interest all physicists, but also carry them with him. On the other hand, his discussion of such points as how we can define, say, silver, and his conclusion that all logical difficulties can be avoided by stating "silver exists," will not, possibly, appeal to the experimenter. The experimenter has never felt the need of a formal definition of his materials; Dr. Campbell agrees, but labours the point at considerable length, whereas the question of modern conceptions of isomers and isotopes, which will bear much discussion, receives little attention.

The book before us (the preface informs us that further volumes have been contemplated) is divided into two parts, one dealing with the propositions of science, and the other with measurement. The first consists in the main of a discussion of the nature of laws, hypotheses, and theories, of what is meant in physics by these terms, and of the possibility of obtaining more or less formal definitions of them. Dr. Campbell's debating often tends to show the difficulty of arriving at conclusions rather than to lead us to convincing conclusions—a fact attributable to the difficulty of the subject. For instance, he suggests that the decision as to whether a given proposition is or is not a law has to be left to the judgment of serious students of science—which is sound, but not sensational. Throughout the book the word "important" plays a large part, and obviously to reduce a question to terms of relative importance is to raise fresh points. The discussion of

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theories, comparing as it does, in particular, the services of mechanical and mathematical theories, is of great interest. The aspect of a theory brought out so strongly by Mendeléeff's words, "By a theory I mean a conclusion drawn from the accumulated facts we now possess which enables us to foresee new facts which we do not yet know," might, perhaps, have been more emphasised.

Of Mill's canons of induction our author disposes in a very workmanlike manner. The chapter on chance and probability seems to us to contain some very sound and valuable remarks on the fundamental assumptions of this difficult study. An example in this chapter has already drawn down the wrath of an eminent mathematician; this example, which deals with the drawing of a given ace from a piquet and a whist pack side by side, at first sight appears to be made the ground of a somewhat perverse comment on ordinary reasoning, since it is admitted that the ordinary estimate of the probability is "right"; but actually it leads up to a point of some importance. The usual assumption is that the choice of either pack in the first instance is equally probable; but this does not follow from first principles unless further conditions as to blindfolding, and so on, are introduced. Actually, the chooser might well be considerably influenced in his choice by the relative size of the packs; and what is really the probability of drawing a given ace is a matter for experiment under conditions rigorously specified. The point brought out, though perhaps not that on which most stress is laid, is that the given conditions are often not stated precisely enough in problems of this nature.

The discussion on probability is continued in the second part, where the subject of errors of measurement is investigated. The criticism here is searching, but is not likely to be accepted in its entirety without debate: the suggestion that the physicist will more frequently find distributions in his notebooks which give a curve like the letter "A" with its top removed than a Gaussian curve will scarcely be accepted. No doubt his arguments will receive more detailed consideration from the experts than is possible here.

The chapter on units and dimensions deserves particular attention. It contains valuable observations on no-dimensional magnitudes and formal constants, as well as some startling suggestions, including what seems to be an implication that the arrangement of the terms in a dimensional equation is of importance.

Dr. Campbell writes with enthusiasm and seeks the combat where it is thickest. The chief fault of his style arises from a desire to deal with every possible comment that might be raised and hence to labour points which are sufficiently obvious. There is a certain lack of co-ordination, which he acknowledges; in fact, one of the things which render it an ungracious task to criticise is that the author is keenly alive to deficiencies in the book, and is always anxious to point them out himself. The work gives the impression of brilliant and informed table-talk on the basis of physics carried on evening after evening, the amount of thought devoted to any particular point depending largely on the mood of the moment. There is little doubt that most readers will find Dr. Campbell provocative in parts, but, whatever else he may provoke, he provokes thought. Finally, it is a great feat to have assembled so much interesting matter, and to have put together a book containing so much fresh thought on a subject of fundamental interest. It is to be hoped that the interest taken in this book will prove amply sufficient to encourage the author to bring out the contemplated remainder of the treatise.

E. N. DA C. ANDRADE.

Mind and Brain.

In Search of the Soul and the Mechanism of Thought, Emotion, and Conduct. By Dr. B. Hollander. Vol. i.: *The History of Philosophy and Science from Ancient Times to the Present Day.* Pp. x+516. Vol. ii.: *The Origin of the Mental Capacities and Dispositions of Man and their Normal, Abnormal, and Supernormal Manifestations.* Pp. vii+361. (London: Kegan Paul, Trench, Trubner, and Co., Ltd.; New York: E. P. Dutton and Co., n.d.) *2l. 2s.* net two vols.

THAT the psychological phenomena loosely grouped together under the term "mind" are in some way correlated with the physiological activities of the brain is a proposition which may be regarded as having been generally accepted for more than a century past; the question, however, as to what is the nature of that correlation still remains unsolved. The fact that this particular question must be allowed to lie in abeyance does not militate against the very legitimate attempt to locate differentiated mental functions in relation to the various structural parts of the brain, and as a matter of course many observers have sought to produce a psycho-physiology of the brain.

The human brain is chiefly remarkable, from the point of view of comparative anatomy, for the extraordinary development of the cerebral hemispheres, which conceal practically all the other portions of the brain. They constitute virtually a great pall consisting of a grey surface or cortex, composed of many layers of innumerable nerve-

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